An Investigation of the Operating Characteristics of Back Up Generators (BUGs) During the ISO-Ordered Rolling Blackout of May 8, 2001

Four Significant Rolling Blackouts in 2001 – March 19 & 20, May 7 & 8.

Information on March Blackouts Was Not Available at Time of Study.

SCE Represented a Larger Portion of The Total Load Reduction on May 8 Than May 7.

SCE Was The Only Utility With Publicly Available Blackout Information

8-May-01

California ISO Load Shedding Detail

	Non-Firm				Firm						
Hour Ending	PG&E	SCE	SDGE	ISO Total	PG&E	SCE	SDGE	CDWR	Pasadena	Vernon	ISO Total
0100				0							0
0200				0							0
0300				0							0
0400				0							0
0500				0							0
0600				0							0
0700				0							0
0800				0							0
0900				0							0
1000				0							0
1100				0							0
1200				0				300			300
1300	60	475	3	538				300			300
1400	60	875	3	938				300			300
1500	60	875	3	938				300			300
1600	60	875	3	938	198.4	168	29.6		1.6	2.4	400
1700	60	875	3	938	198.4	168	29.6		1.6	2.4	400
1800	60	875	3	938							0
1900	60	875	3	938							0
2000				0							0
2100				0							0
2200				0							0
2300				0							0
2400				0							0

The exact times and number of megawatts interrupted are approximate and based on information provided by the Utility Distribution Companies

Prepared by: EO (CAISO)

10/17/2001

"Firm" Customers

Total Load Reduction of 2000 MW-hrs Ordered Between 1200 and 1700 hours on May 8.

800 MW-hrs From 5 Public/Private Utilities (PG&E, Pasadena, SCE, SDGE, and Vernon)

SCE Ordered to Provide 336 MW-hr (42% of Utility Total)

1200 MW-hrs Ordered From CDWR

"Firm" Customers

CDWR Reported Water Pumps Were Shut Down Versus BUGs Started Up.

Thus, 60% of ISO-Ordered Curtailment From "Firm" Customers Was Accomplished Without The Use of BUGs.

Historical Rotating Outage Information

Date	Hour Ending	Off Time	On Time	MW	Automated Groups	Nonautomated Groups	Subtrans Groups
05/08/2001	1600 1700	1512 1612	1612 1712	225 163	A25-A28 A29-A30 & A32		
05/07/2001	1700	1648	1748	136	A22-A24		
03/20/2001	1000 1100 1200 1300	0926 1025 1125 1125	1026 1125 1411 1411	200 200 158 158	A21 Counted ACCP Counted ACCP	M05	
03/19/2001	1900	1810	1912	348	A17-A20		
03/19/2001	1300 1300 1400 1400 1500 1600	1200 1235 1256 1335 1433 1530	1257 1337 1355 1435 1530 1615	223 458 447 481 423 373	A01 A02-A05 A06 A07-A11 A12-A16	M01-M04	

"Firm" Customers

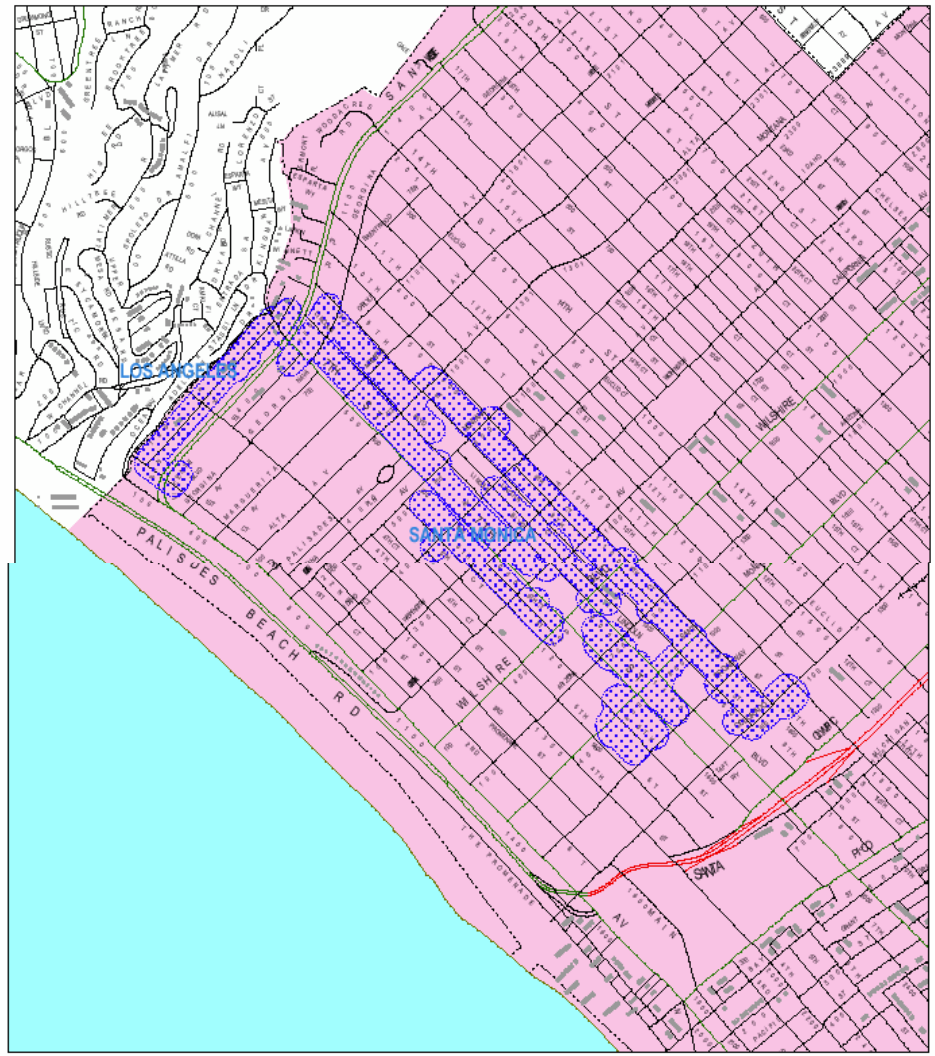
As Shown, 7 SCE Outage Groups (A025-A030, A032) Were Affected By The Order.

These 7 Outage Groups Incorporate a Total of 129 Sub-Regions or Discrete Transmission Systems

These 129 Sub-Regions Encompassed 77 Incorporated Areas and Numerous Unincorporated Areas in 3 Counties.

SCE Website Provided Maps of Each Sub-Region

Rotating Outage Map - Group A025



"Firm" Customers

CEC's Statewide BUGs Inventory Was Filtered For Each of The 77 Incorporated Areas.

This Yielded Street Addresses of BUGs Within These Areas

MapQuest Was Utilized to Create a Map of Each Address

Address Maps Were Compared With SCE Sub-Region Maps

BUGs Identified Within The Curtailment Boundaries Were Placed on The Call List

"Firm" Customers

Zip Code Software Was Used to Identify The ZIP Codes For The Affected Unincorporated Areas

The CEC Statewide BUGs Inventory Was Filtered by Zip Code

This Yielded Street Addresses of BUGs Within These Areas

Address Maps Were Compared With SCE Sub-Region Maps

BUGs Identified Within The Curtailment Boundaries Were Placed on The Call List

"Firm" Customers

Of the 4103 BUGs in CEC's Statewide Inventory, 159 Identified As Being Within The May 8 Outage Areas

80 Of The 159 Were Successfully Contacted

43 Of The 80 Were Not Subjected To The Blackout

37 Of The 80 Were Affected By The Blackout

21 Of The 37 Did Not Use On-Site Power Generation

16 Of The 37 Did Operate Their BUGs

"Firm" Customers

Region	Number BUGs	Fraction of Total	Of Fraction Surveyed	Of Fraction Receiving Power Curtailment
BUGs in State (CEC Inventory)	4103	100.0%		
Total BUGs in SCE May 8 Power Curtailment Regions	159	3.9%		
BUGs at facilities that were successfully contacted	80	1.9%	100.0%	
BUGs at facilities sharing service line with essential public services (no curtailment)	18	0.4%	22.5%	
BUGs at facility in SCE Optional Binding Mandatory Curtailment Prgm (no curtailment)	25	0.6%	31.3%	
BUGs at facilities that were ordered to curtail power	37	0.9%	46.3%	100.0%
BUGs at facilities that were ordered to curtail power that actually operated their BUGs on May 8, 2001	16	0.4%		43.2%
BUGs at facilities that were ordered to curtail power but did not use their BUGs	21	0.5%		56.8%

"Firm" Customers

Average BUGs Operation Was 4.88 Hours

Average Size Of Bug Operated Was 725 kW

Average Operating Load Was 85%

Average Effective Size Of BUG Was 615 kW

Index	Number BUGs	Comment
BUGs in SCE Curtailment Areas	159	Analysis of SCE Curtailment Maps
Fraction of BUGs at surveyed facilities where power was ordered to be curtailed	0.463	As Shown in Slide 12
Estimation of BUGs in facilities ordered to curtail power	73.5	Extrapolation (159 x 0.463)
Fraction of BUGs actually operated at power curtailed facilities	0.432	As Shown in Slide 12
Estimation of BUGs operated in SCE region during May 8 power curtailment	32	Extrapolation (73.5 x 0.432)
Average hours BUGs were operated	4.88	Survey of facilities operating BUGs
Average power produced by BUGs (kW)	615	Survey of facilities operating BUGs
Estimated total power produced by BUGs in SCE region on May 8, 2001 (MW-hrs)	96.0	Extrapolation ((32 x 4.88 x 615)/1000)
Cal-ISO Demand Reduction Required of SCE (MW-hrs)	336.0	Cal-ISO historical record
Percent of Demand Reduction Achieved in SCE Region Through Overall Operation of BUGs	28.6%	Calculated (96/336)
Percent of Demand Reduction Achieved in SCE Region Through Operation of BUGs During 2-Hour Outage Period	11.7%	Calculated ((0.286/4.88)x2)

"Firm" Customers

Number of BUGs Operated in Other Utility Areas Extrapolated From The SCE Data

Example: PG&E = 396.8 x 0.117 / (0.615 x 2) = 38

"Firm" Customers

Utility Region	Power Curtailment (MW-Hrs)	Estimated BUGs Generation (MW-Hrs)	Total Number of BUGs Operated on May 8, 2001
Pacific Gas and Electric	396.8	113.5	38
Southern California Edison	336	96.1	32
San Diego Gas and Electric	59.2	16.9	6
California Department of Water Resources	1200	0	0
Pasadena	3.2	0.9	0
Vernon	4.8	1.4	0
Total Megawatt-Hours	2000	228.8	76
Actual Total Fraction of Statewide Demand Reduction Attributable to Operation of BUGs		4.7%	

8-May-01

California ISO Load Shedding Detail

	Non-Firm				Firm						
Hour Ending	PG&E	SCE	SDGE	ISO Total	PG&E	SCE	SDGE	CDWR	Pasadena	Vernon	ISO Total
0100				0							0
0200				0							0
0300				0							0
0400				0							0
0500				0							0
0600				0							0
0700				0							0
0800				0							0
0900				0							0
1000				0							0
1100				0							0
1200				0				300			300
1300	60	475	3	538				300			300
1400	60	875	3	938				300			300
1500	60	875	3	938				300			300
1600	60	875	3	938	198.4	168	29.6		1.6	2.4	400
1700	60	875	3	938	198.4	168	29.6		1.6	2.4	400
1800	60	875	3	938							0
1900	60	875	3	938							0
2000				0							0
2100				0							0
2200				0							0
2300				0							0
2400				0							0

The exact times and number of megawatts interrupted are approximate and based on information provided by the Utility Distribution Companies

Prepared by: EO (CAISO)

10/17/2001

"Non-Firm" Customers

AB-621 Required Electric Utilities to Make Interruptible Service Customer List Publicly Available

SCE Provided a List of 3410 "Non-Firm" Customers

List was matched by name and address to CEC statewide inventory

"Non-Firm" Customers

84 BUGs Owners/Operators Identified Through Matching

44 of The 84 Were Successfully Contacted

10 of The 44 Operated BUGs On May 8, 2001

These 10 Locations Operated a Total of 31 BUGs on That Date

"Non-Firm" Customers

A Second Survey Was Conducted

Survey Set Consisted of Every 20th Customer on SCE's Interruptible Service List

This Yielded a Set of 171 Facilities

122 of The 171 Facilities Were Successfully Contacted

15 of The 122 Facilities Had Diesel-Fueled BUGs on May 8, 2001

5 of The 15 Facilities Operated Their BUGs on May 8, 2001

These 5 Facilities Operated a Total of 8 BUGs on That Date

"Non-Firm" Customers

	Survey 1		Survey 2		Combined Surveys		
Indicator	Number	Fraction	Number	Fraction	Number	Fraction	Source
Total Interruptible Customers in SCE Area	3410	100%	3410	100%	n/a	n/a	SCE List
Number of Customers That Provided Information	84	n/a	122	3.6%	n/a	n/a	122/3410
Customers With BUGs in Survey	44	n/a	15	12.3%	59	100%	15/122
Customers Owning BUGs That Used Them on May 8	10	22.7%	5	33.3%	15	25.4%	10/44, 5/15, and 15/59
Number of BUGs at Facilities Using Their BUGs	31	n/a	8	n/a	39	n/a	From Phone Survey
Number of BUGs Used Per Facility	3.1	n/a	1.6	n/a	2.6	n/a	39/15
Number of Facilities in SCE Area Likely Using BUGs on May 8	107						3410 x 0.123 x 0.254

"Non-Firm" Customers

Average BUGs Operation Was 5.1 Hours

Average Size Of Bug Operated Was 998 kW

Average Operating Load Was 95%

Average Effective Size Of BUG Was 948 kW

"Non-Firm" Customers

Indicator	Number	Source
Number of BUGs Likely to Have Operated on May 8, 2001	278	107 x 2.6
Electricity Generated (MW-hrs)	1344	278 x .948 x 5.1
SCE Load Reduction Required by Cal-ISO (MW-hrs)	5725	Cal-ISO Historical Record
Percent of Required Load Reduction Attributable to Operation of BUGs	23.4%	1344/5725
Average Effective Size of BUGs Operated on May 8, 2001 (kW)	948	Phone Survey
Average Duration of BUGs Operation on May 8, 2001 (hours)	5.1	Phone Survey

"Non-Firm" Customers

Number of BUGs Operated in Other Utility Areas Extrapolated From The SCE Data

Example: PG&E = 420 x 0.234 / (0.948 x 5.1) = 20

"Non-Firm" Customers

Utility Region	Power Curtailment (MW-Hrs)	Estimated BUGs Generation (MW-Hrs)	Total Number of BUGs Operated on May 8, 2001
Pacific Gas and Electric	420	98.3	20
Southern California Edison	5725	1344	278
San Diego Gas and Electric	21	4.9	1
California Department of Water Resources	0	0	0
Pasadena	0	0	0
Vernon	0	0	0
Total Megawatt-Hours	6166	1447.2	299
Actual Total Fraction of Statewide Demand Reduction Attributable to Operation of BUGs		23.4%	

Combined "Firm" and "Non-Firm" Customers

Utility Region	Firm Customers (MW-Hrs) Adjusted to Two-Hour Outage Period	Non-Firm Customers (MW-Hrs)	Total (MW-Hrs)	Total Requested Curtailment (MW-Hrs)	Fraction of Reduction Provided by BUGs
Pacific Gas and Electric	46.5	98.3	144.8	816.8	17.7%
Souther California Edison	39.4	1344	1383.4	6061	22.8%
San Diego Gas and Electric	6.9	4.9	11.8	80.2	14.8%
California Department of Water Resources	0.0	0.0	0.0	1200	0.0%
Pasadena	0.4	0.0	0.4	3.2	11.7%
Vernon	0.6	0.0	0.6	4.8	11.7%
Total	93.8	1447.2	1541	8166	**18.8%**

Overall Results

	Firm Customers	Non-Firm Customers	Total
Number of BUGs Operated	76	298	374
MW-Hrs Generated	228.8	1443.1	1671.9
NO_x (tons)	2.09	12.79	14.88
SO_2 (tons)	0.05	0.29	0.34
PM_{10} (tons)	0.05	0.33	0.38
CO_2 (tons)	174	1072	1246
CO (tons)	0.36	2.2	2.56
VOC (tons)	0.01	0.06	0.07

Determination of Locations of BUGs Operated on May 8, 2001

Coordinates of BUGs Needed for Modeling

For SCE's "Firm" Customers:

Those Cross-Matched With CEC Statewide Inventory – Coordinates Taken Directly From Inventory

The 77 Incorporated Areas in SCE Region Were Ranked According to The Number of BUGs Shown in The Statewide Inventory

Extrapolated BUGs Were Apportioned Based on Area's Ranking

The Locations of Actual BUGs in Those Areas Were Used

Determination of Locations of BUGs Operated on May 8, 2001 (cont.)

For SCE's "Non-Firm" Customers:

Where Effectively Cross-Matched – Coordinates Taken From Statewide Inventory or,

Coordinates Established From Addresses in SCE's Interruptible Service Customer List or,

Coordinates For Extrapolated BUGs Based Upon Ranking of Areas in The Interruptible Service Customer List – Locations of Actual Interruptible Service Customers Used

Determination of Locations of BUGs Operated on May 8, 2001

For BUGS Not in SCE Region:

Counties And, in The Case of San Diego County, Zip Codes Were Ranked According to The Number of BUGs Listed in The Statewide Inventory For Each Area

BUGs Were Apportioned Based Upon Area Rankings

Locations of Actual BUGs Contained in Statewide Inventory Were Used